

The Global Ocean
Observing System



GOOS BioEco

*The Biology & Ecosystems Panel of GOOS:
integrating biology and ecosystem monitoring*

<http://ioc-goos.org/biology>



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



CSIRO



MARINE MAMMAL COMMISSION



Australian Government



AUSTRALIAN INSTITUTE
OF MARINE SCIENCE



THE UNIVERSITY OF
WESTERN
AUSTRALIA

Informing Priorities for Biological and Ecosystem Observations, supporting evolution of the U.S. Integrated Ocean Observing System (IOOS)

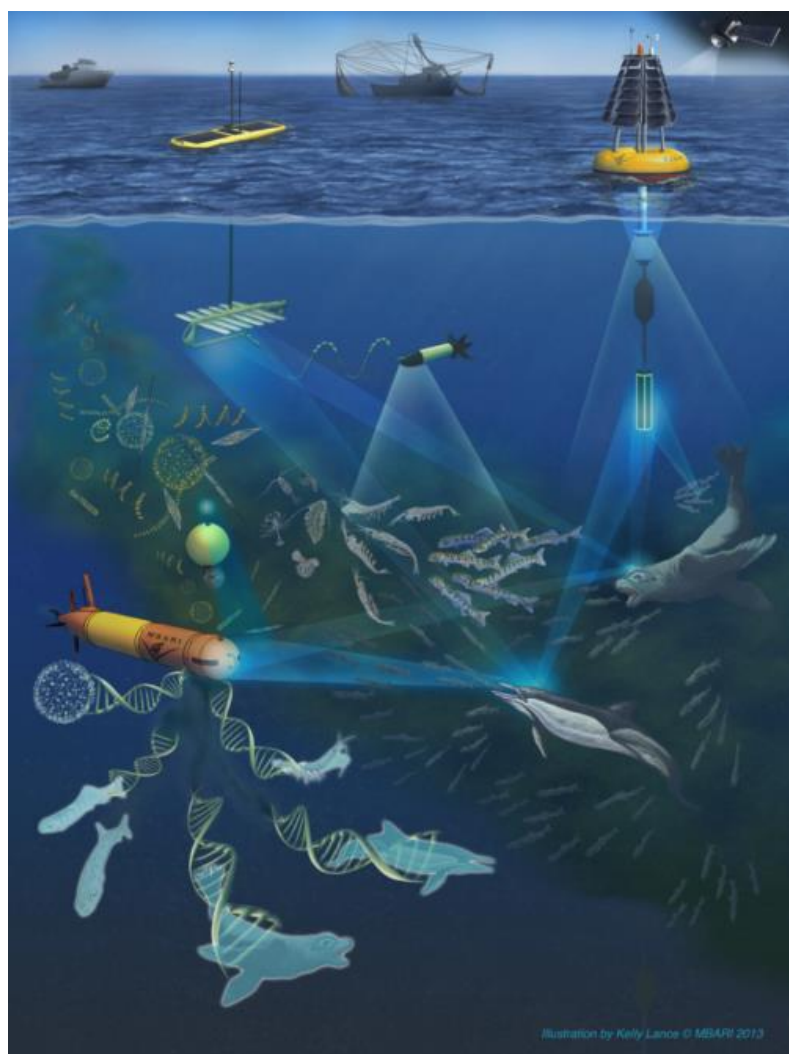


Illustration by Kelly Lanoie © MBARI 2012

Credit: MBARI

Samantha Simmons
U.S. Marine Mammal Commission
Chair, Biological Integration
and Observation (BIO) Task Team.



Why Biology and Why Now?

- 26 core IOOS variables
 - Phytoplankton species
 - Zooplankton species
 - Zooplankton abundance
 - Fish species
 - Fish abundance
 - 2012 IOOS Summit
- <http://www.iooc.us/summit/>

Acidity
Bathymetry
Bottom Character
Colored Dissolved Organic Matter
Contaminants
Dissolved Nutrients
Dissolved Oxygen
Heat Flux
Ice Distribution
Ocean Color
Optical Properties
Partial Pressure of CO ₂
Pathogens
Salinity
Sea Level
Stream Flow
Surface Currents
Surface Waves
Temperature
Total Suspended Matter
Wind Speed and Direction

Task Team Goals

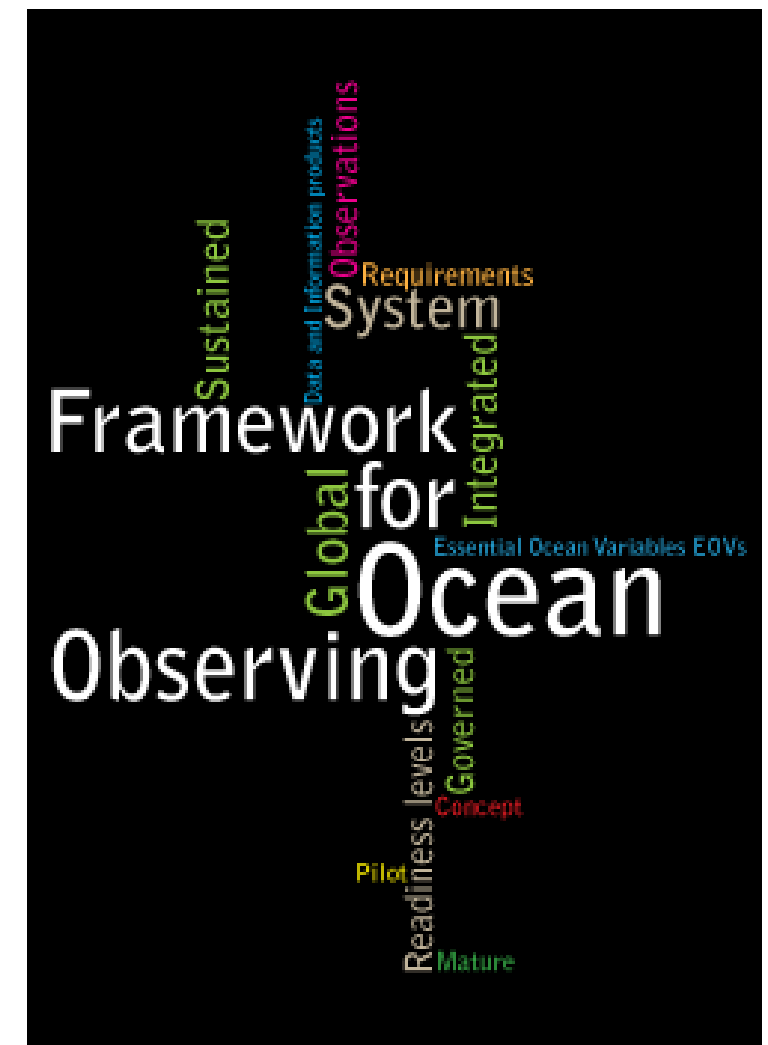
A. Improve the availability of existing IOOS core biological variables

- phytoplankton species (and abundance)
- zooplankton species
- zooplankton abundance
- fish species
- fish abundance

B. Identify, and prioritize additional cross-cutting biological and ecosystem observation needs

The Framework for Ocean Observing

- Ocean Obs '09
- Characterize observing systems across disciplines & technologies
- Establish priorities for observing
- Identify readiness levels
- <http://www.oceanobs09.net/foo/>



Task Team Activities

B. Identify, and prioritize additional cross-cutting biological and ecosystem observation needs

- Survey of needs for biological and ecosystem observations

REQUIREMENTS

- Expert workshop (Community input)

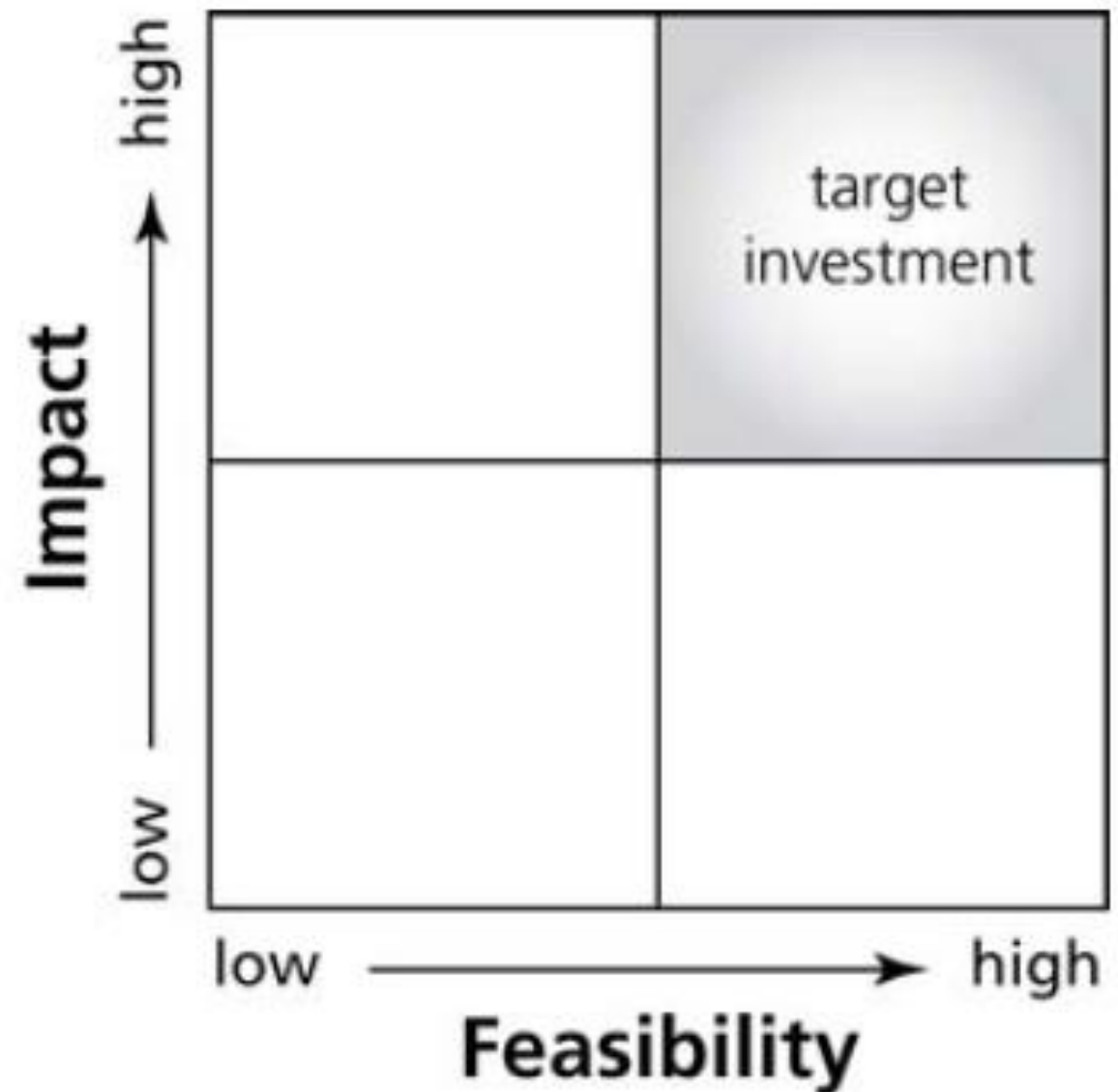
IMPACT and **FEASIBILITY** analysis

Outputs – reports and recommendations

Survey results ~60 variables. Workshop down to 36

Impact : Feasibility Analysis

- First, prioritize each of the variables based on IMPACT (Low, Medium, High, Essential)
- Second, prioritize each variable based on FEASIBILITY (Concept, Pilot, Mature)

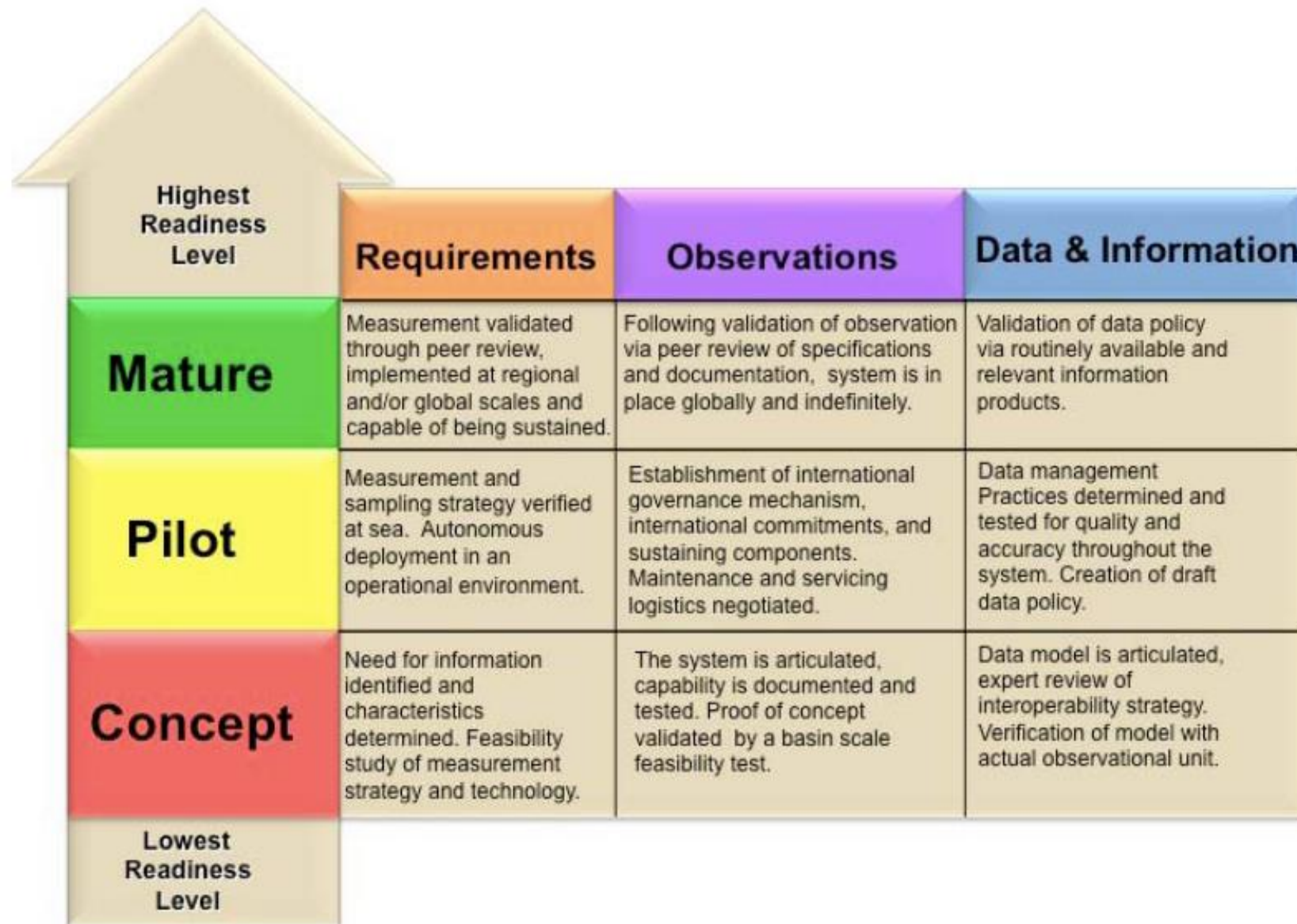


IMPACT Rating

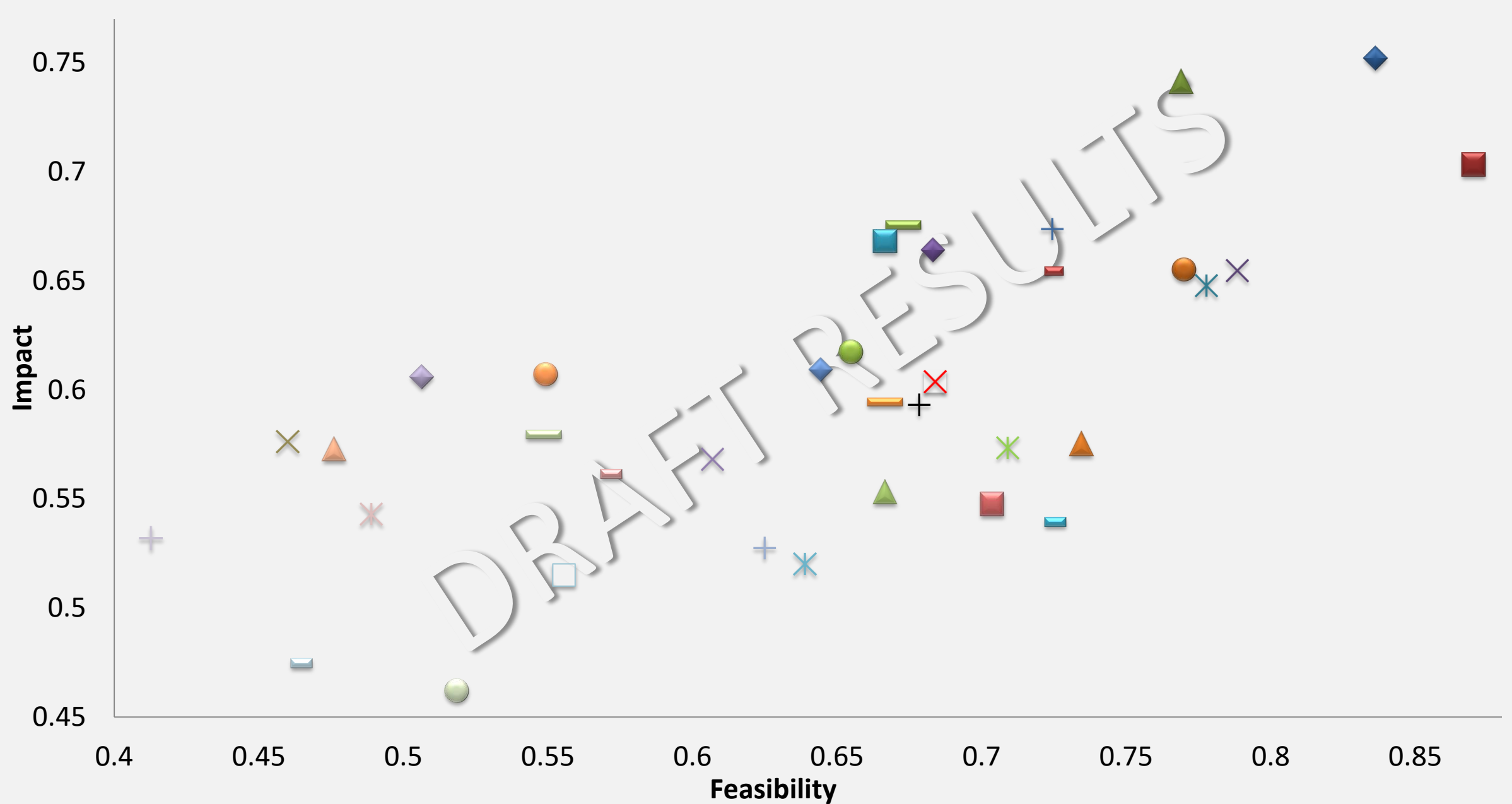
- Each variable scored based on 5 Themes (GOOS BEP):
 - Productivity
 - Biodiversity
 - Ecosystem Services
 - Human Activities & Pressures
 - Scientific Benefit

FEASIBILITY Rating

- For each variable scored based on readiness level for requirements, observations, data & information



Highest Readiness Level	Requirements	Observations	Data & Information
Mature	Measurement validated through peer review, implemented at regional and/or global scales and capable of being sustained.	Following validation of observation via peer review of specifications and documentation, system is in place globally and indefinitely.	Validation of data policy via routinely available and relevant information products.
Pilot	Measurement and sampling strategy verified at sea. Autonomous deployment in an operational environment.	Establishment of international governance mechanism, international commitments, and sustaining components. Maintenance and servicing logistics negotiated.	Data management Practices determined and tested for quality and accuracy throughout the system. Creation of draft data policy.
Concept	Need for information identified and characteristics determined. Feasibility study of measurement strategy and technology.	The system is articulated, capability is documented and tested. Proof of concept validated by a basin scale feasibility test.	Data model is articulated, expert review of interoperability strategy. Verification of model with actual observational unit.
Lowest Readiness Level			



- ◆ fish abundance
- ✕ marine mammal abundance
- + coral abundance
- ◆ fish fecundity
- ✕ zooplankton abundance
- + submerged aquatic vegetation species
- ◆ sound
- ✕ marine mammal fecundity
- + sea bird diet
- ◆ benthic invertebrate abundance
- ✕ microbial species
- + benthic invertebrate fecundity

- primary productivity
- ✕ marine mammal species
- phytoplankton species
- submerged aquatic vegetation abundance
- ✕ seabird species
- sea turtle abundance
- sea turtle species
- ✕ seal diet
- pelagic invertebrate nekton species
- sea turtle fecundity
- ✕ zooplankton fecundity
- microzooplankton grazing

- ▲ fish species
- phytoplankton abundance
- coral species
- ▲ sea bird abundance
- zooplankton species
- fish diet
- ▲ sea bird fecundity
- benthic invertebrate species
- coral recruitment
- ▲ microbial abundance
- sea turtle diet

Recommendations (preliminary)

We must consider interactions, both spatial and temporal, among climate, physics, chemistry, **and biology**.

- Highest priority should be to include species and abundance of other core functional groups (pelagic and benthic) that are not in the current core variables list
- Following species and abundance, biological vital rates (BVRs) are the next priority of biological information to be included as IOOS core variables. BVRs include, production, recruitment, mortality, fecundity, growth, and feeding rates
- Also, information on nekton diet should be included as an IOOS core variable
- Finally sound should be included as an IOOS core variable

The Global Ocean
Observing System



GOOS BioEco

*The Biology & Ecosystems Panel of GOOS:
integrating biology and ecosystem monitoring*

<http://ioc-goos.org/biology>



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



Australian Government



AUSTRALIAN INSTITUTE
OF MARINE SCIENCE



THE UNIVERSITY OF
WESTERN
AUSTRALIA



Ocean observations for societal benefit

Climate, real time services, ocean health

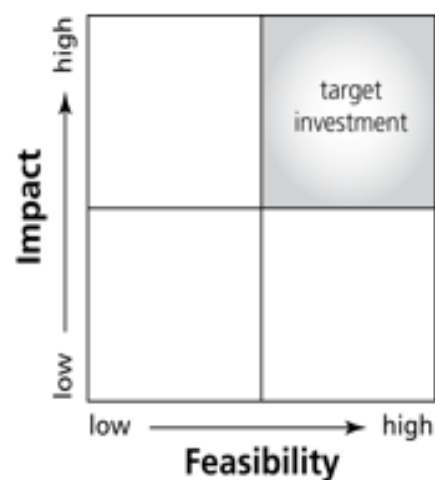
A permanent global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide.

Provides:

- accurate descriptions of the present state of the oceans
(Essential Variables: climate, ocean, biodiversity)
- continuous forecasts of the future conditions of the sea
- the basis for forecasts of climate change



Guiding policy through Essential Ocean Variables



ESSENTIAL OCEAN VARIABLES (EOVs)

Physics and climate	Biogeochemistry	Biology and ecosystems
<ul style="list-style-type: none"> • Temperature • Salinity • Sea level • Sea state • Sea ice • Current • Ocean colour • Carbon dioxide partial pressure (pCO₂) • Nutrients • Carbon • Ocean tracers 	<ul style="list-style-type: none"> • Oxygen • Macronutrients • Carbonate system • Transient tracers • Suspended particulates • Particulate matter export • Nitrous oxide • Carbon-13 • Dissolved organic matter 	<p><i>Proposed:</i></p> <ul style="list-style-type: none"> • Chlorophyll • Harmful Algal Blooms (HABs) • Zooplankton (biomass/abundance) • Mangrove and seagrass area • Coral Cover • Salt Marsh Area • Large marine vertebrates (movement/abundance/distribution)

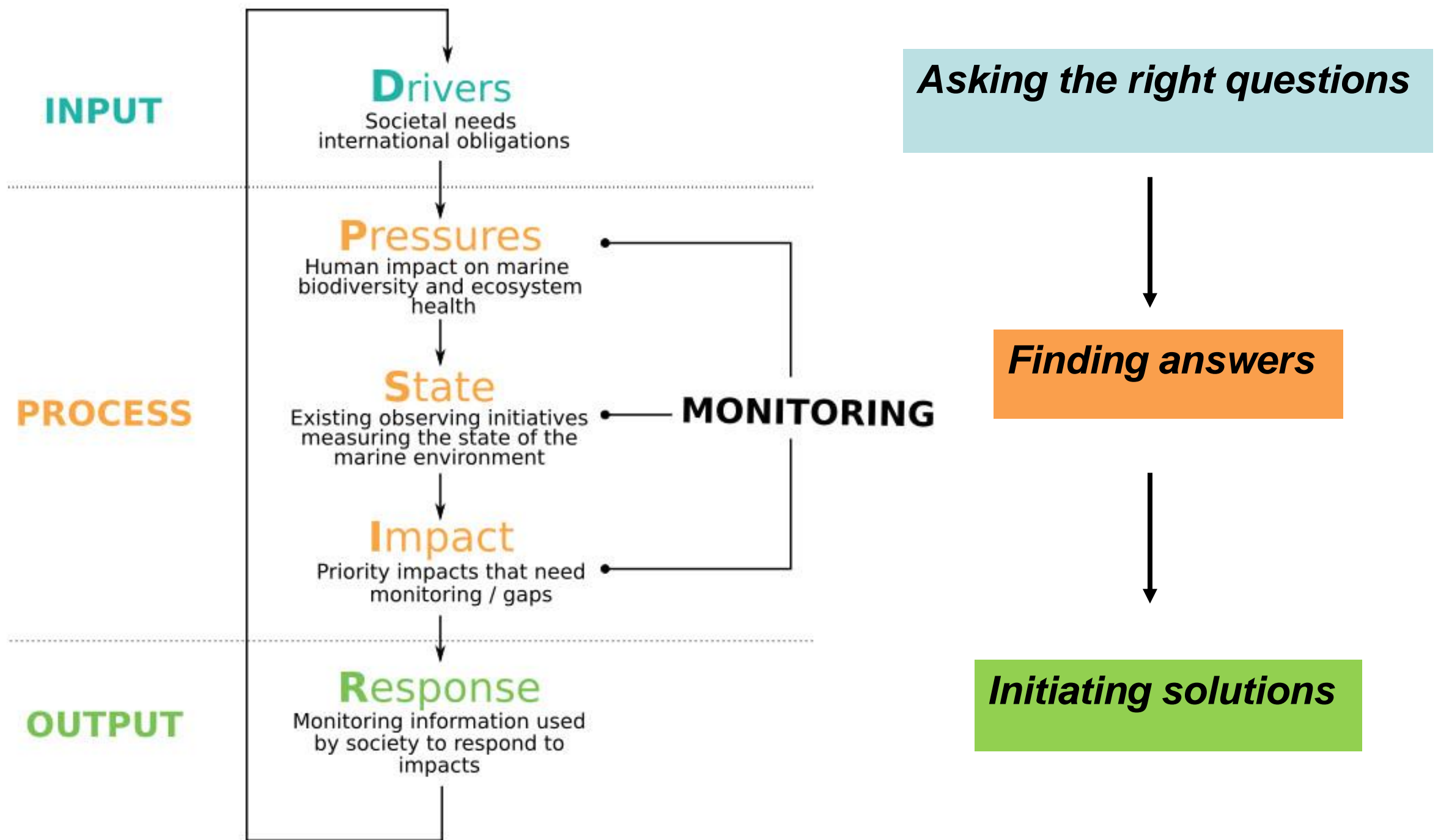
GOOS BioEco

Goals

- Develop and coordinate efforts in the implementation of a sustained and targeted global ocean observation system **driven by societal needs** to include EOVs.
- Answer **relevant scientific and societal questions**, and facilitate policy and management development on ocean and coastal resource sustainability and health.



Defining BioEco EOVs: The DPSIR model



Identifies the information needed to understand and manage human impacts on the environment

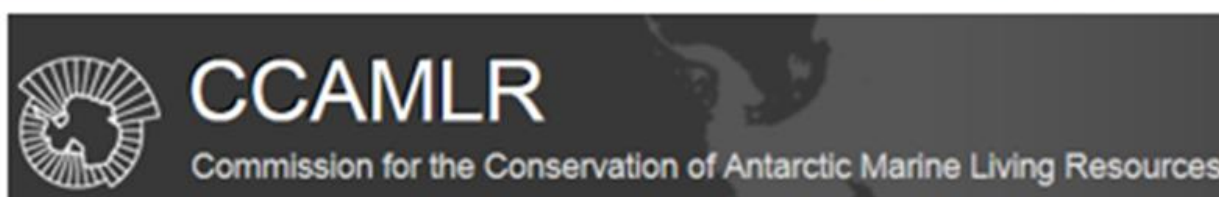


Defining the DRIVERS and PRESSURES

International organizations / conventions*



United Nations
Framework Convention on
Climate Change



Defining the DRIVERS and PRESSURES

Provisional results:

DRIVERS

- Sustainable use: biodiversity and resources in general
- Knowledge: science / data access
- Conservation: biodiversity and ecosystems
- Capacity building: technology transfer
- Development: sustainable economic growth
- Improve management: integrate ecosystem approach
- Threat prevention and impact mitigation (to pressures)
- Environmental quality (health)
- Food security

PRESSURES

- Loss of resources
- Pollution/Eutrophication
- Climate change
- Invasive species
- Coastal development
- Solid waste
- Acidification
- Extreme weather events
- Noise
- Mining

Assessing the State

Observation / data integration*



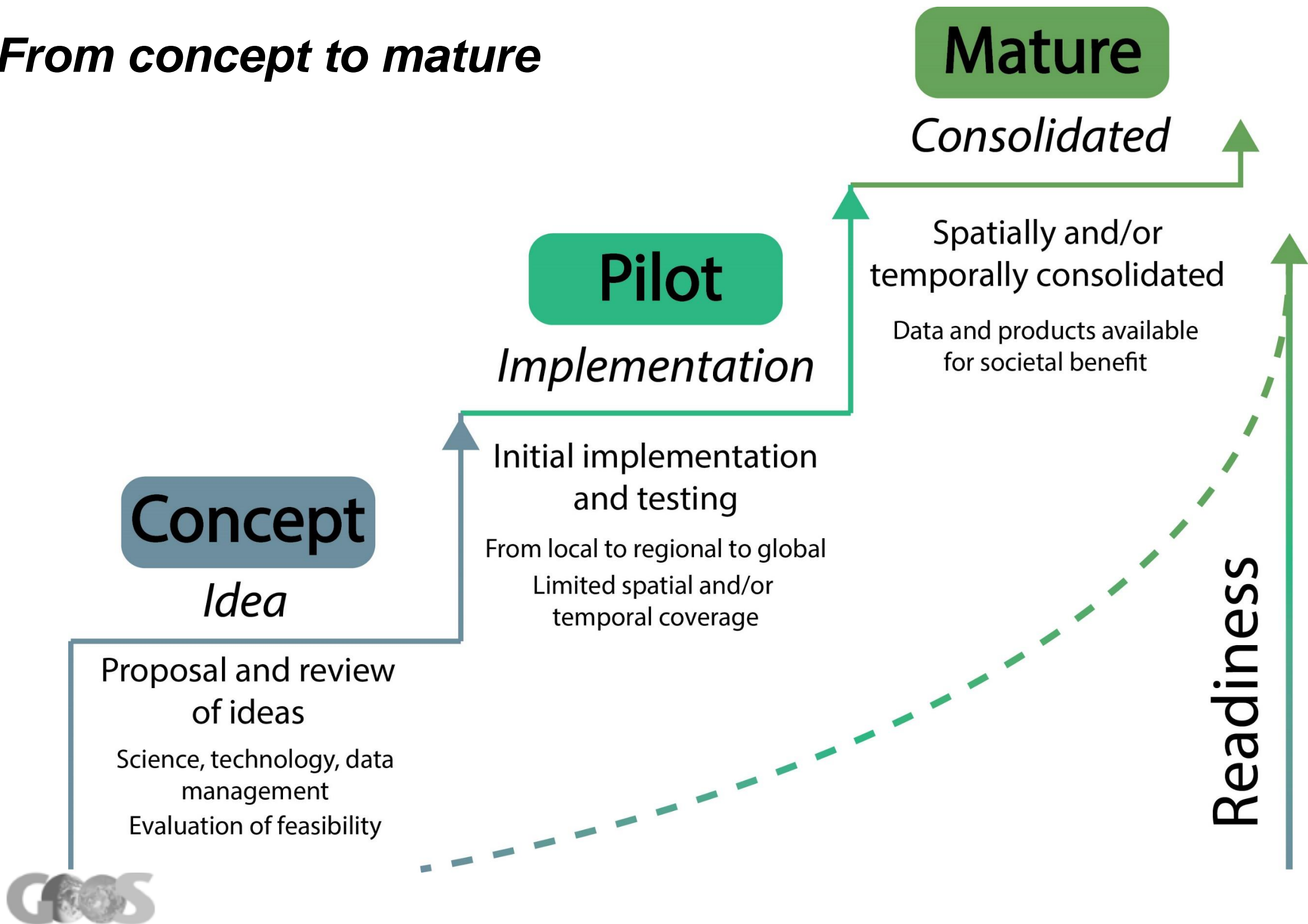
Survey for ocean observing programs

- Driver of program
- Methods – standards
- Geographic area
- Spatial scale
- Temporal coverage
- Temporal frequency
- Major system
- Habitat
- Taxonomic coverage
- Key variables measured
- Data repository and quality control
- Data access



Readiness of ocean observations

From concept to mature



GOOS BioEco: tasks ahead

By 2019, coinciding with the OceanObs'19:

- Implement a mature observation programme of at least one (set of) EOVs providing an indicator of change, globally coordinated aimed for global coverage, open access data, and to support international reporting needs
- Identify a further 3 (sets of) pilot EOVs with a clear pathway to progress to mature programmes.



GOOS BioEco: leadership & panel members

Member	Institutional affiliation	Country	Key Links	Expertise
Nic Bax	CSIRO	Australia	SOOS / IMOS	Biodiversity/ ecosystems modelling
Sam Simmons	Marine Mammal Commission	USA	IOOS / OTN	Marine mammals / tracking
Patricia Miloslavich	Universidad Simon Bolivar / Australian Institute of Marine Science	Venezuela	SARCE	Marine biodiversity / Benthos
Ward Appeltans	UNESCO / IODE office of IOC	Belgium	OBIS	Marine biodiversity / databases
Member	Institutional affiliation	Country	Key Links	Expertise
Frank Muller-Karger	University of South Florida University California Santa Cruz	USA	CARIACO, US-NMS, MBON, GEOBON WG5 Task Team (marine)	Time series / Remote Sensing Oceanography Phytoplankton ecology and harmful algal blooms
Raphael Kudela	SAHFOS	USA	HABs	Zooplankton monitoring
Sonia Batten	JAMSTEC	Canada	GACS	Long term changes zooplankton / trophic structure
Sanae Chiba	Scripps Institution of Oceanography, UCSD	Japan	GACS	Long-term changes in pelagic zooplankton and fish
David Checkley	CORDIO	USA	CalCOFI / PICES / FOO	
David Obura	Tennenbaum Marine Observatories / Smithsonian Institution	Kenya	IUCN, GEOBON, bioDISCOVERY, GCRMN/ICRI/ISRS	Coral ecology and biodiversity, climate change biology
Emmet Duffy	University of Pisa	USA	GEO / ZEN	Marine biodiversity and ecology (seagrass and coral reefs) Experimental design and ecology / statistics (rocky shores)
Lisandro Benedetti-Cecchi	IRD	Italy	EMBO	
Yunne Shin		France	IndiSEAS	Biodiversity/ ecosystems modelling

Questions?

Samantha Simmons

ssimmons@mmc.gov



The BIO Task Team

Bob Houtman - Interagency Ocean Observation Committee

Sarah Miller – U.S. Army Corps of Engineers

James Price - Bureau of Ocean Energy Management

Samantha Simmons (Chair) - Marine Mammal Commission

Michael Weise - Office of Naval Research

Hassan Moustahfid - Integrated Ocean Observing System

Rebecca Shuford - National Oceanic & Atmospheric Administration

Kandace Binkley - National Science Foundation

Mark Fornwall - US Geological Survey

Raphe Kudela – Regional Associations (CeNCOOS)

Jay Pearlman, Eileen Hofmann - RCN

Support: Nick Rome, Hannah Dean – Consortium for Ocean Leadership